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Determining the fate of exudates within the major carbon pools of arable soils

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A broader knowledge of the contribution of C released by plant roots (exudates) is a prerequisite for optimising the management of organic matter in arable soils. This is the first study to reveal the contribution of constantly applied 13C labelled natural (maize and wheat) and artificial exudates to water extractable organic carbon (WEOC), microbial biomass-C (MB-C), and CO2-C evolution during incubations with material of two agricultural soils with different yields. These soils were chosen, since it was assumed that their nutrient and C fluxes are different from each other, reflected in their different yield pattern. Due to methodological limitations, natural exudates were only applied to the soil with lower yield. WEOC, MB-C, CO2-C, and the respective ä13C values were measured regularly. A newly developed method for determining ä13C values in soil extracts was applied. In case of incubated natural exudates, significant effects with similar incorporation patterns for both exudates were detected in all investigated C pools. The exudates were recovered to ca. 26% after the incubation, in the order WEOC<MB-C<CO2-C for maize and MB-C<WEOC<CO2-C for wheat. In case of incubated artificial exudates significant incorporation of substrate derived C was observed in the MB-C and CO2-C pool, but not in WEOC in both soils. Added exudate-C was determined in the investigated pools to ca. 50% after the incubation, in the order WEOC<<MB-C<CO2-C. MB-C values had a similar contribution to the balance in both soils. CO2-C showed a significantly higher value in the soil with the lower yield, supporting the assumption of different C-fluxes in the investigated soils. In both incubations, newly built microbial biomass consisted mainly of exudates, presumably causing a change in the microbial structure. Correspondingly, the net CO2 balance was dominated by exudate C, showing a preferential use of this substrate. Our results suggest that the remaining percentage of the added

exudate became stabilized in non water extractable organic fractions. This assumption was supported by the determination of organic C in the soils at the end of the incubation with artificial exudates, where the respective amounts were recovered. Moreover, it is concluded that priming effects can be explained by exchange processes between soluble C-components and the soil matrix.